1862MNRAS..23...18L

For the following abstract of Mr. Auwers' paper, On the Irregularities of the Motion of *Procyon*, and on the Determination of the Elements of an obscure Companion of *Procyon*, the attraction of which will explain these irregularities, the Society and myself are indebted to W. T. Lynn, Esq., Assistant of the Royal Observatory of Greenwich.

It may be necessary to correct a misunderstanding that might possibly be produced in the minds of some readers by the expressions of the first paragraph. The irregularities in the annual motions of stars generally, and of *Procyon* in particular, were first pointed out by Mr. Pond. In the *Greenwich Observations*, 1820–22, is a Table of "Right Ascensions of the 36 Stars of the Greenwich Catalogue, reduced to the beginning of the year 1819, from five years' observations with the new Transit Instrument, 1817–1821, and compared with Dr. Maskelyne's Catalogue of the year 1805 brought up to the same period;" the principal discordances are those of α^2 *Capricorni*, *Sirius*, *Spica*, *Procyon*. In the *Greenwich Observations*, 1825, is "A Table showing the difference between the predicted and observed N.P.D. of 45 principal fixed stars for the year 1826;" the principal discordances are those of α *Pegasi*, γ *Aquilæ*, *Sirius*, *Procyon*. In the *Philosophical Transactions*, 1823, page 36, Mr. Pond says, "A very great deviation in N.P.D. will be found in three very bright stars, *Capella*, *Procyon*, and *Sirius*;" in page 44 he again specifies *Procyon* and *Sirius*, and in page 529, he speaks of the impossibility of exactly interpolating or predicting a star's place. Finally, in the Introduction to the Catalogue of 1112 stars, dated June 27, 1833, he says, "We can hardly desire a better test of our power of predicting the future position of the stars, than by trying by the same formulæ how accurately we can interpolate for the past. In a variety of papers, which I have submitted at times to the Royal Society, I have endeavoured to show that *with us* the latter experiment entirely fails."

G. B. Airy.

Abstract of the Paper by Auwers on the Proper Motion of Procyon, contained in Nos. 1371, 1372, *and* 1373, *of the Astronomische Nachrichten.*

In this paper Auwers first gives the history of the investigations made into the proper motions of *Sirius* and *Procyon* thus: Bessel discovered in 1844 that the observed Right Ascensions of *Sirius* and Declinations of *Procyon* negatived the existence of an invariable Proper Motion of those stars, and showed that its variability was to be explained by the attraction of bodies connected with them, and forming thereby binary systems, the remaining components of which were not perceptible to us, or at least had not hitherto been perceived. Doubt was on various sides thrown upon this result, new,

1862MNRAS..23...18L

surprising, and founded as it was upon very small quantities, measurable only by means of very frequently repeated observations, until Peters in 1851 demonstrated that the irregularities in the observed Right Ascensions of *Sirius* were such that they could be completely explained by the assumption of a periodical motion about a neighbouring point, itself in uniform motion; further proof of this explanation has since been afforded by investigation of the observed Declinations of that star. The argument for the existence of a similar variability in the Proper Motion of *Procyon* was greatly increased when Mädler in 1851 showed that irregularities were evidenced in its observed Right Ascensions as well as Declinations. Up to the present time, however, the question, as regards *Procyon*, has been considered an open one; Auwers, therefore, last year (1861) undertook and executed a new investigation of it, the principal features of which are contained in the paper before us, and the result of which has completely, he tells us, confirmed Bessel's hypothesis.

In this investigation he has made use of all the available published observations of *Procyon* from 1750 to 1860, using for stars of comparison in R.A. α *Tauri*, β, α *Orionis*, β *Geminorum*, α *Hydræ*, and α *Leonis*; and in N.P.D. α *Ceti*, α *Orionis*, α *Serpentis*, γ, α, β *Aquilæ*, and α *Aquarii*. The latter list agrees with Bessel's, save that Auwers has omitted β *Virginis*, because it has only exceptionally been observed at the English Observatories. The comparison is effected by comparing the observed place of each star with its computed place in the *Tabulæ Regiomontanæ*. After giving several tables of the results obtained from observations during the above-mentioned times, made principally at Greenwich (Bradley, Maskelyne, Pond, and Airy), Königsberg, Edinburgh, Oxford, Cambridge, Geneva, and Washington, he remarks that inspection alone is sufficient to prove the certainty of changes in the Proper Motion, and therefore he need only occupy himself with the question whether these changes are capable of being explained by the assumption of a motion in a binary system. And he finds that the irregularities are of the nature that they may be explained by the assumption of a circular motion of *Procyon*, in a plane perpendicular to the line of sight, round a point about $1''\cdot2$ distant. After trying this assumption and correcting it according to the method of least squares, he at last forms the following set of elements of the motion of *Procyon*:—

		Probable Error.
Epoch of Minimum R.A.	$= 1795\cdot5676$	$\pm\, 0^{y}\cdot4457$
Yearly Motion	$= 9^{\circ}\cdot00634$	$0^{\circ}\cdot09110$
Periodic Time	$= 39^{y}\cdot972$	$0^{y}\cdot4043$
Radius of Orbit	$= 1''\cdot0525$	$0''\cdot0275$

Then follows a Table containing a comparison of these ex-

1862MNRAS..23...20D

pressions with observations, which shows "that the representation of the latter by the elements is perfectly satisfactory," there being no remarkable deviation in any part of the orbit, but the differences from observation having the character of being fortuitous, and following no law.

In order to be able to assign a limit to the mass of the invisible companion of *Procyon*, he has deduced a provisional approximate value of the parallax of that star from a series of observations with the Königsberg heliometer, not originally commenced with any view to such a determination. He has thus obtained for that parallax the value $0''\cdot123$, with the probable error $\pm\ 0''\cdot033$; "with this number," he says, "we should find from the above elements that the mass of the dark body must be greater than 0·4 that of the Sun. We may assume with certainty that the parallax of *Procyon* is less than $0''\cdot2$; in any case therefore the dark body must have a mass at least a hundred times as great as that of *Jupiter*. If *Procyon* and its companion have equal masses, that of each must be greater than 0·37 that of the Sun, and if the mass of *Procyon* is equal to that of the Sun, that of its companion must be greater than 0·6 that of the Sun."

The paper concludes with a table of the corrections to be applied according to this theory to the Right Ascensions and Declinations of *Procyon* in the *Tabulæ Reductionum* from the year 1750 to 1880.

W. T. L.

Rule for the Solution of Kepler's Problem.
By M. de Gasparis.

(*Communicated by the President.*)

Exemple. Soit $M = 27^\circ\ 12'\ 33''\cdot62 = E - (9\cdot8947213)\sin E$.

Je pose $A = 9\cdot3471561$, qui s'obtient en otant log. *e* du nombre 9·2418774, qui est le logarithme de 10° en parties du rayon.

Après cela l'on prend les $\log \frac{\sin(M+10^\circ)}{1}$, $\log \frac{\sin(M+20^\circ)}{2}$, $\log \frac{\sin(M+30^\circ)}{3}$, etc., et l'on s'arrète lorsque le résultat est proximément $> A$.

Le but de cette opération est d'approcher E à 10° près. Il suffit donc d'envisager les premiers chiffres, et pourvu que l'on sache les premiers chiffres des logarithmes des nombres simples,